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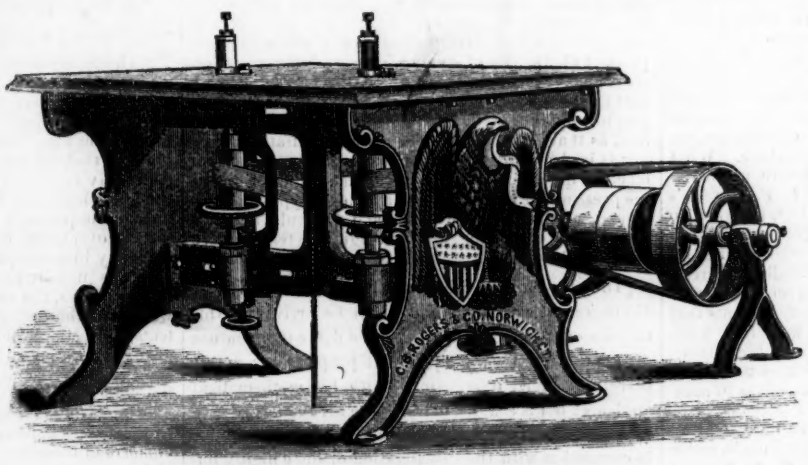
## Upright Shaping Machine.

Great improvements have been made in this class of machines, which add greatly to the value and usefulness of the machine. It has a very heavy iron frame, with iron top and girts, and is strong, and calculated for the heaviest work. The arbors, which are made of the best English steel, run in a frame or gateway, with boxes cast solid to it, so as to be always in line. The box and steps are patented. The top box is self oiling, having an oil chamber and cup for oil. The step, or lower box, consists of an outer box enclosing an inner one, which is babbitted and tapering, with a steel plug for the arbor to rest upon, and is self-oiling, having a chamber, and conducting channels for oil. The inner box can be adjusted to take up the loose motion as it wears. These boxes obviate the tendency which all upright shafts have, to heat. The arbors have screws by which the heads can be varied above the table, when required to work brackets or wide curved moldings. The machines are furnished with a new patent head, in which cutters may be used whole or in sections, being held by caps; and the heads can also be taken off and others put on without removing the cutters. The inventor makes the following sizes of heads: 1 inch, 1¼, 2, and 2¼ inch diameter, which can be used on this machine. They also furnish with each machine one pair of heads, usually the 2 inch—unless otherwise ordered—and a set of cutters. Each machine has a counter-shaft, the tight and loose pulleys of which are 10 inch diameter, 4 inch face, and should make 940 revolutions per minute, giving the heads 5000. Weight, boxed, 1250 lbs.




UPRIGHT SHAPING MACHINE.

Further information can be had on application to C. B. Rogers & Co., 109 Liberty street, New York.

## Oil Report.

There has been quite a feeling of depression among the oil producers here this week, says the Wyoming *Petrolia Advertiser* of June 19th, owing no doubt to the partial failure of the large refining firm in Hamilton, in making an article of refined up to their expectations; which we understand is due to their not having the distilling portion of their refinery ready for operation; and consequently were obliged to engage refiners here and elsewhere, to make the distillate for them This they claim has not been done with sufficient care. And as the distilling is as particular a part of the operation as the refining, they propose making no more until they get their own stills ready for work. They are building a still near the Fairbank siding, in this place, for that purpose, containing 2800 barrels capacity, which they intend to have ready for operation by the first of next month.

The "Standard" refinery here has also partially suspended operations, merely running but a small fraction of their capacity, And as these parties took away the greater proportion of the production of the place, for the last few months, and now discontinue doing so; it throws quite a gloom among parties who have good pumping wells, when they find their tankage filling up and their pockets getting empty; and seeing no present means of getting rid of the former so as to supply the latter.

These are about the only reasons I can see for a dullness in the trade at present. But we understand there is an Italian treatment now going on in the Wyoming refineries with perfect success; and as soon as the Hamilton company get into operation, and also a large firm in London, now erecting a refinery there, of about 3000 barrels capacity per week, under the management of a Mr. Berringer, of the firm of Englehart & Co., New York; the producer will then get his oil off his hands, the tanks will be emptied, and the temporary feeling of a downward tendency will disappear.

Notwithstanding the temporary feeling of depression alluded to, there are still more new wells going down: and the place is filing up with strangers, who seem to take a most decided interest in the welfare of the oil business.

Mr. Hyde of this place, has just finished drilling a well on the Fairbank estate, immediately east of the G. W. R. station; which from the shows obtained promises to be a good well. And we sincerely hope he may not be disappointed. For the pluck he has shown during the last year, in trying to produce oil under difficulties, he deserves some recompense.

Mr. Spencer of Loudon, who is sinking a well on the Hill estate, and south of the wells owned by Parsons & Elwood, has also, I am informed, got a small show of oil. He will finish drilling about the end of the present week.

The price of crude remains the same as quoted last week, viz.: $1.62½ for the home, and $1 25 for the foreign trade; at which last figure there was a sale made this week, by the Crude Association, of 10,000 barrels to Mr. Berringer, before alluded to.

**The French Telegraph Cable.**—The expedition charged with the work of submerging the French cable and subsequently connecting the shores of the United States and France arrived at Duxbury, Mass., on the 23d ult. The shore ends of the line was laid in order, and one other of the great works of the age consummated. The wire is working splendidly. Boston is already awake. Her citizens and municipality have decided to enjoy a grand cable celebration after the fashion, near as they can, of the magnificent display made by New York over the Atlantic cable at Newfoundland. Two British steamers were standing in with the shore end at sunrise, and were expected to make their destination in the forenoon. The terminus of the line from Saint Pierre is fixed at Rouse's Hummock, near the Gurnet Light, at the entrance of Plymouth harbor. Duxbury is quite animated. Telegraph men are constructing two land routes of wire, one from Duxbury to Boston, and a second, by the French cable company, along the Old Colony and South Shore Railroad. As a solid assurance of the effect of the enterprise we are told that the value of real estate in Duxbury has advanced 100 per cent in thirty days.

# Chemical Repertory.--No. 11.

AUGUST 2, 1869.

15. The Relations of Luminosity and Flame-Temperatures, Under Varying Tensions.

[Concluded, from our last Issue.]

"I have said that if the flame of hydrogen becomes luminous at a high pressure, it is because the temperature increases with the pressure. Let us see now the consequences of this fact, supposing it well established. M. Debray and myself found the temperature of combination of hydrogen and oxygen, at the ordinary pressure, to be 2500° C. We determined this by pouring into water a kilogramme of platinum, fused and brought to the highest temperature possible in a furnace of quicklime, the data for calculation being the elevation of temperature of this water, with the specific heat of platinum according to Pouillet, and its latent heat according to Person. It was our desire to control by a great number of trials, a result so important, and so far as the data would permit, to establish it incontestably. For this it was necessary to employ great masses of platinum and to subject ourselves to very grave accidents and terrible explosions, to which we failed however to fall victims. While we were occupied energetically with this research, Bunsen published his beautiful Memoir upon the temperatures of combustion."

[This investigation of Bunsen is to be found in *Poggendorff's Annalen* 131, 161; July, 1867. I am not aware that this important Memoir of the most eminent of Gas-Chemists has ever been translated into English, and it certainly is a stranger to most American readers. I propose therefore, at an early day to translate it, condensed as much as possible, for this Journal.]

"The excellence of the method of the great Heidelberg scientist dispenses altogether with our own critical and dangerous processes, especially as Bunsen's numbers are in perfect accord with ours. He gave 2800° C. (5072° F.), as the heat of combination of the two gases, pure and dry, in his valved eudiometer. Taking into account the moisture in the gas employed in our experiments, and the nitrogen introduced into our gas-holders with the water, we arrive at a number very near to 2800°, which I therefore adopt as the true temperature. The number 2500° gave me, as the proportion of the gas really burning at the moment when the dissociation of water corresponding to this temperature arrests the union of its elements (that is, at the maximum temperature possible under the conditions), 44 per cent.; 2800° gives 50 per cent.

The valved eudiometer has enabled Bunsen to investigate also the temperature of combustion when the total pressure on the mixed gases is brought *below* that of the atmosphere. This he did by adding an inert gas to the mixture. The temperature then decreased rapidly and proportionally. Consequently the amount of dissociated matter, or the tension of dissociation, decreases with the elevation of the temperature. What do we find now if we seek the temperature of combination *above* the atmospheric pressure? Frankland's experiments indicate it manifestly. But, in order to obtain absolute certainty on this subject, special verifications are needed, which may be obtained either by fusing platinum in an atmosphere artificially compressed, or by repeating therein Bunsen's experiments with the valved eudiometer. These are the experiments that I intend commencing, in a laboratory with iron walls capable of sustaining a pressure of at least three atmospheres, a pressure which the experiment of the bridge of Kehl has shown to be absolutely harmless to mankind.

The practical consequences will be at once comprehended, which may flow from experiments made under pressure with ordinary combustibles. * * * It is in the expectation of furnishing by this means to the engineers of the navy, data for calculation, that the Emperor has desired these investigations to be made in the *Ecole normale*. A great chamber of iron, capable of holding the operator and his apparatus, and of supporting a considerable pressure of air furnished by a steam pump, will constitute a laboratory in which all the necessary manipulations may be conducted without danger.

It, as may be deemed almost demonstrated by the above, and by all the testimony of engineers and physicians regarding chambers containing compressed air; if the temperature actually rises with the pressure, this would be an analogy the more to add to the great number I have shown between the phenomena of combination and decomposition on the one hand, and the phenomena of condensation and volatilization of liquids on the other hand. In fact, that which is improperly designated the *point of ebullition* of a liquid we may call the *maximum temperature of condensation* of the vapor. This temperature is none other than that at which a vapor no longer condenses on the surface of a cold thermometer, which latter is heated solely by means of the latent heat yielded to it by the vapor in the midst of which it is plunged. The point of ebullition, or temperature of condensation, rises, as is known, when the pressure is increased. The phenomenon is more complex in appearance, but perfectly correlative to the act of condensation of vapors, when we look at the combination of bodies; for example, that of oxygen and hydrogen, in the compound blowpipe.

[The analogies which Deville here claims to have pointed out, between dissociation and evaporation, and between combination and condensation, have given rise to much discussion. They are opposed by Schroeder *van der* Kolk, but strongly sustained by Pfaundler (Poggendorff's *Annalen* 131, 55). Some results of Berthelot, contained in a paper of his on *Chemical Equilibrium*, in the June number of the *Bulletin de la Societe Chimique*, appear to have an important bearing, and will receive further attention from us. As to combustion under pressure, there is an important paper published many years since by our countryman Professor Leconte, in the *American Journal of Science:* which appears to anticipate much of what has been done of late on this subject abroad. We shall return again to this also.]

"Admitting that the temperature of combination of H and O is 2800° C., the amount of HO formed in the flame, at the pressure of 760 mm., at the hottest point, would be

$$\frac{637 + (2800-100)\,0{,}475}{3833} = 0.5$$

or only half of the O and H present in equivalent proportions in the mixture."

[Deville does not give the origin or signification of his divisor 3833, but refers to authorities inaccessible to us, for explanation of the above expression. I would suggest, however, that 3833 is very closely 34,462 (the calorific equivalent of H) divided by 9 (the number of pounds of HO formed by 1 lb. of H). 637 is of course the sum of the latent and sensible heats of steam. I cannot take time or space here to investigate this expression mathematically, proposing, however, to do this at a subsequent time.]

"But, if we increase the pressure, the temperature of the flame also increasing, it is evident from the above formula, that the proportion of matter combined, or of watery vapor formed, must increase proportionally with the pressure; exactly as the tension of a saturated vapor increases proportionally with the temperature. In fine, the combining temperature of a gaseous mixture, like the maximum temperature of condensation (or point of ebullition) of a vapor, rises with the pressure.

"The combined matter in the flame plays the same part as the matter condensed in a space filled with vapor, in which the temperature and pressure are so varied, as that the vapor may be always saturated.

"It is clear from this, that the quantity of uncombined or dissociated matter in the flame diminishes as the pressure increases. We may then suppose a pressure at which a mixture of H and O would actually engender, in combining, that unimaginable temperature of 6800° C. which corresponds to total combination."

[The present writer has never met with Deville's discussion of this subject, in which he arrives at this number of 6800° C. as the maximum flame-temperature of O and H burning in equivalent proportions; and is therefore wholly unacquainted with his mathematical methods; but is enabled to introduce here some interesting remarks. In the course of the last fall and winter, in connection with the investigation of some highly important improvements in gas manufacture not yet brought fully before the world, the writer had occasion in conjunction with Professor B. Silliman, of New Haven, to enter into the mathematical discussion of the whole subject of flame-temperatures of common gases and mixtures thereof, starting, *ab initio*, with the fundamental data furnished by the researches of Regnault, Favre and Silbermann, and others. The number arrived at for the temperature of the compound blowpipe flame, dissociation being left out of the consideration, was 6851° C., a sufficiently near approximation to to that of Deville. This is equal to 12,364° Fahr., a temperature which Deville may well call "unimaginable." I may add that Bunsen, in an earlier edition of his Gasometry (English edition of 1857, p 242) gives a far higher number for this same temperature, namely 8061° C; the greater part of the discrepancy appearing, on examination of Bunsen's methods, to be due to the singular omission, on his part, of one of the most important factors, the absorption of heat as latent heat of the steam formed in the combustion. Doubtless this must have been corrected in the later (German) editions of Bunsen, but after considerable inquiry and search, I have not been able to meet with one of these in our city (which is far from famous for its resources in scientific literature, we blush to confess). Any of our readers who can furnish to us Bunsen's latest number for this maximum flame-temperature of hydrogen in oxygen, or, better, his passage relating to it, entire, will place us under much obligation. It is purposed, by Silliman and Wurtz, to communicate a part of their investigations regarding Flame-Temperatures to the American Association, at its Salem meeting, now near at hand.—H. W.]

M. Deville concludes by saying:

"But in regard to this, it is no more possible to offer a serious hypothesis than it would be to ask if there be a pressure at which water can no longer enter into ebullition, whatever may be the temperature applied to it."

After this long quotation from his previous paper Deville goes on to add:

"In Frankland's communication contained in this present number of the *Revue*, it is apparent that the author concedes a much larger part than in his communication of October 12th, for the action of temperature in explaining the luminous phenomena of flame. On mature reflection, I am now, on my side, disposed to find, in the greater or less density of the gas in combustion, a cause of increase of the light emitted. The brilliancy of a flame may be considered as dependent, or possibly so, upon:

"1. The number and disposition of the specific rays that the substances existing in the flame can give by spectral analysis.

"2. The temperature to which the elements of the flame are carried.

"3. Finally, their density.

"The considerations conveyed in my note above quoted lead to the easy admission of the first two causes. As to the third, introduced as a principle by Frankland as following from his fine researches, it may be conceived in the following manner:

"Biot, in his studies of rotary molecular polarization, showed that the phenomena of deviation of the plane of polarization effected by active substances are proportional:

"1. To the thickness of the layer traversed by the light.

"2. To the proportion, by weight, of active material present.

"3. To the density of the material itself.

"These, according to him, were the characters of an action called by him *molecular*; for example, that exerted by oil of turpentine upon a polarized ray traversing a line of molecules of this substance placed in the path of the ray. Analogically, it is possible to comprehend that the intensity of the light produced by a flame may be proportional to its density, if we admit the following hypothesis; to which, however, I attach no more importance than Dr. Frankland does to the theory of atoms, but which, nevertheless, serves to make my idea comprehensible.

"It is usually assumed that gases contain, in the same volumes, the same number of atoms, and that the weights of those atoms are proportional to the equivalents, when the latter are properly chosen; these equivalents bearing also the name of atomic weights. But it may also be admitted that all gases contain, either the same species of atoms, or even atoms of different kinds, but of equal weights. On this view, the equivalents of gases and vapors would be proportional to the *numbers* of these atoms contained in the same volume; and in gases having densities proportional to their equivalents, these densities would be equally proportional to the numbers of atoms contained in the same volume. I suppose that each atom, in burning, emits a certain amount of light. The intensity of this light would be proportional: *First*, to the number of these atoms, that is to say, to the density of the matter in combustion; *Second*, to the temperature, that is to the square of the velocity of the vibrations of the molecules put in motion by the heat; *Finally*, in that the particles of an inert gas, like nitrogen, mixed with hydrogen and oxygen, becoming themselves incandescent under the influence of the heat, may increase the luminosity of the mixture.

"I present this hypothesis as ranking in value with all hypotheses relating to the intimate constitution of bodies. When we talk of *molecules* and *atoms*, we explain nothing, but we nevertheless express our thoughts in language of elementary signification. This suffices for me.

"Pressure, having the effect of increasing the density of gases, should equally increase their luminosity. This is what Dr. Frankland admits. But it may also

be admitted that pressure diminishes the tension of dissociation of the matter resulting from the combination of the elements of the flame; and consequently that the temperature of this flame increases with the proportion of the elements really combined. This is a conclusion that experiment is adequate to test, and it is by the realization of such test that I hope to arrive at a knowledge of the true cause of the beautiful phenomena discovered by Dr. FRANKLAND.

"HENRI SAINTE-CLAIRE DEVILLE,
"Membre de l'Institut,
"Professeur à l'Ecole supérieure et à la Faculté des sciences de Paris.'

—*Revue des Cours. Scientifiques*, 13 *Mars*, 1869, *p.* 232.
H. W.

## American Chemical News.

In introducing, with the above title, a new and special department of the REPERTORY (which has however been contemplated from the first), some hesitation is felt. Duty must nevertheless be done, however irksome, and truth must be told, unpleasant and unpopular though it be. In the collection of chemical intelligence from European sources, the greatest difficulty arises at this present day, from the superabundance of material. The giant Discovery there has on his "Seven league boots" (which we take to mean nothing more than *hard work*), and his strides are so vast and rapid and diverge into so many new paths, that probably no finite intellect may longer follow up and grasp the whole. Far otherwise in these our boasting cisatlantic States. Hoodwinked as are the masses of our people on this subject, it is nevertheless true that the part we play, and the share we merit, in the glorious conquests of the human mind over nature now so oft announced on the Bulletins of Science, is really lamentably small. Indeed, to a well-informed and unprejudiced man, the mere notion that America is a land in which scientific discovery and progress (especially in the science of chemistry) keep pace with wealth and population, or with the spirit of the age, is a mere matter of laughter, or rather (if himself an American) of shame! The undeniable truth is that there is no increase, and indeed a more than probable falling off, in the number of true chemical workers in our country. No one for a moment can attribute this to a lack of the intellectual attributes necessary to constitute successful chemical discoverers; which, we ourselves solemnly believe, are even more widely distributed among us than among any other people. The true causes lie deeper, and we shall not attempt fully to discuss them now, saying merely that the chief one is that we present the remarkable spectacle, the first probable in the history of civilization, of a community which, as a whole, not merely ignores, but has adopted a *fashion of despising*, those who lay the foundations of civilization, by developing the hidden principles which alone advance the empire of Mind over matter. A perverse demon has ruled Americans now for a decade, and his name is Practicality. That we may not be deemed by some to stand alone in such views as these, we shall echo a voice that has come to us across the breadth of the Continent, in the columns of that most sterling of our popular scientific contemporaries—the San Francisco *Mining and Scientific Press:*

"In scientific matters there has been wanting an enlightened public opinion, the effect of which has been curiously different—the existence in every locality of a considerable number of boldly assuming, but secretly little self-respecting persons, who are esteemed above the honest men of science, while our noble and world-renowned scientific men are strangely undervalued, or almost unknown to our worthless 'public opinion.'

"The first geologist of our times, certainly amongst the greatest living lights in that science, (esteemed in Europe quite as highly as are Lyell, Murchison and Naumann), is DANA, who is not merely an authority, but is the author of the best comprehensive works on Geology and Mineralogy extant in any language, a deep philosopher of the problem of creation, and as scientist and man, worthy of our profoundest reverence. America has never been proud of DANA, nor of its other worthy men of the same stamp."

There is a small number of hopeful men, of whom we claim to be, who believe that the reign of this Incubus is on the wane; and that the time is at hand for the natural reaction in the American mind that always follows after a popular prejudice that has been tried and found wanting. Should we be correct in our prognosis, there will be an increasing need of journals such as we propose this shall be; of media through which the new race of American working chemists can at once communicate with the scientific world. We therefore again offer, as we have before, to all such, the use of these columns for all communications involving novelty of thought or discovery; and in the mean time, shall do our endeavor, with the means and *materiel* at our hands, to present to our readers a journal of the progress of chemistry in America. Another plan we have to announce for the first time, which is already matured, and for which we believe the time is quite ripe; a plan whose execution is destined greatly to forward the cause of chemical science in America. This is the programme of an AMERICAN CHEMICAL SOCIETY. An early occasion will be taken to lay before the chemists of America the details of this plan; to the fulfillment of which, *Deo volente*, the AMERICAN CHEMICAL REPERTORY is here and henceforth pledged to do its utmost. The chemical status of America must and shall be redeemed, and maintained. HENRY WURTZ]

### THE CHEMISTRY OF THE SUN.

[We have introduced into the REPERTORY, from time to time, a few items upon this subject, without venturing to appropriate the space that would be needed fully to follow its present rapid and varied developments. As these developments, however, are clearly constituting one of the most wondrous chapters in the whole history of scientific discovery, it is incumbent on us to give it its due share of attention. The interest excited by this and kindred topics, even among some who make no special pursuit of scientific inquiry, will be illustrated by a recent remark of an esteemed friend, a Minister of the Gospel, to the writer, on the latter expressing his surprise at the eagerness with which he was questioned by the former on this subject. "I *hunger* and *thirst* after such knowledge," said he, "and there are many like me." Renewed interest is soon to be awakened in this direction by the results of American observations upon the total eclipse which is to visit this continent on the seventh of this month; and doubtless many of these results will be first made public at the annual session of the AMERICAN ASSOCIATION for the ADVANCEMENT OF SCIENCE, at Salem, Mass., during the third week in this month; which the writer hopes and expects to attend. In the mean time, we cannot do better than copy from the *Yale College Courant* some portions of an article, evidently from the able pen of Professor GEORGE F. BARKER, which forms a most eloquent introduction to the subject.—H. W.]

"Celestial chemistry has come forward to take its rank among the sciences with a rapidity which is truly astonishing. It is not yet ten years since the distinguished Professor at Heidelberg (Bunsen) observed that each chemical element, when incandescent, gave a spectrum peculiar to itself, and thus provided us with a new method of qualitative analysis; and already, this simple fact has become the corner-stone on which one of the mightiest temples recorded in the history of science is being reared. In the hands of Kirchhoff it revealed to us the physical and chemical constitution of the sun. Applied by Huggins, fixed stars and comets were analyzed, nebulous matter was discovered in space, Laplace's wonderful theory was confirmed, and astonishing chemical changes were observed in progress at distances which the human intellect is staggered to comprehend. Stoney takes the spectroscope and tells us how vapor densities which we cannot obtain on the earth, may be taken by a child on the surface of the sun. Sorby uses it, and straightway a sure and positive method of detecting the purity of dye-stuffs is given us. Herapath studies it, and immediately there starts up in the path of the criminal a detective who will discover with the unerring certainty of light itself, the traces of his brother's blood. Roscoe and Lielegg have applied it to the Bessemer process, and a uniform and excellent quality of steel is cheaply obtained. Bunsen himself did not let it go till it had presented him with twin elements, born of light. Crookes and Lamy for the first time beheld in it the green line of thallium And Reich and Richter used it as a magic wand by means of which the Freiberg blendes became transparent to their view and indium was discovered. All this has been accomplished, and spectrum analysis has not yet completed its first decade! Who shall limit its powers in the fields of research which yet lie before it?

"The new instrument which thus promises so much, is claimed alike by physics, by chemistry and by astronomy. And while we admit that it has aided the two former sciences to the most directly practical results, and has made itself felt through them on our advancing civilization more profoundly, no one can deny, on the other hand, that the reach of its power in astronomy is on a far grander scale, and that its achievements among stars and nebulæ, which have created the science of celestial chemistry, are far more wonderful, To the sun, the private luminary of our system, it has paid special attention; showing us, first, that it consists of a highly luminous and intensely heated nucleus, surrounded by an incandescent atmosphere composed of the vapors of sodium, of magnesium, of iron, of copper, of nickel, of cobalt and of many other metals. These, secondly, approaching more closely, it has looked into the sunspots and has shown that these are cavities in the luminous photosphere, produced by the sudden influx into it of cooler masses from an exterior atmosphere, thus displacing in part, and in part obscuring the luminous envelope. Another, and a third phenomenon, however, had been discovered by the telescope, still more remarkable. During the solar eclipse of 1860, several astronomers, collected on the line of totality in Spain, observed protuberances like tongues of flame shooting out from the sun's surface to a great distance. Here was another opportunity to test the capabilites of the new science. Wait till the great total eclipse of 1868, said the astronomers, and then we shall know the character of these protuberances. The interest excited in the approaching eclipse was very great. Governments and learned societies organized parties of observation, furnished them with all the necessary appliances and sent them to the Indian Ocean. The French government sent Rayet to Wah-Tonne, on the Peninsula of Malacca; Janssen, on behalf of the Académie des Sciences and the Bureau des Longitudes, stationed himself at Guntoor in the province of Madras. The Royal Society of England provided Lieut. John Herschel with the means of observation at Jamkandi, in the province of Bombay; the Royal Astronomical Society sent Major Tennant to Guntoor; Haig observed at Beejapoor, and Henessey at Barram Point on the island of Borneo. Prussia sent one expedition under Dr. Vogel to Aden and another to Beejapoor. And Austria fitted out a party of observation under Weiss, who established themselves in Aden. These expeditions had in view two leading objects; first, the solar protuberances were to be accurately photographed; anp second, their physical and chemical constitution was to be determined by the spectroscope. The apparatus to be used in both of these undertakings was of the finest description; the resources of modern science being taxed to make it perfect. The observers were men eminent in science; and a generous national rivalry urged them to take all the precautions and to put forth all the energies necessary to a successful result.

[Professor BARKER here condenses in a masterly way, some of the accounts given by the different expeditions of their adventures, their exciting successes and failures; appertaining to the romance of science; but, intensely interesting as it all is, our space is too precious. He concludes as follows.]

The observations appear to establish three facts concerning the protuberances: 1st, they are gaseous matter in a state of incandescence, the largest shooting out to a distance of seventy thousand miles from the sun's surface. 2d. All the protuberances have a precisely similar composition. And 3d, the red and blue rays of their spectra—corresponding to the lines C and F of the solar spectrum—prove this gas to be hydrogen.

Some farther results of great interest and value have been obtained from the spectral examination of this eclipse. But these we must defer a notice of until another time.

[On reference to the first of the *Excerpta* in the last (July 16) issue of the REPERTORY, it will be seen however, that all the observers did not obtain uniform spectra from the protuberances.—H. W.]

### BUTTER MAKING.

Having been much pleased by the perusal of an Essay on this topic by Professor JAMES A. WHITNEY, of New York, which contains much interesting and wholesome chemistry, we present the *cream* of it to our readers:

Butter exists in milk in the form of minute globules, which are transparent. Each globule is surrounded by a thin covering of casein, and the globules are lens-shaped. This gives them the property of dispersing light in all directions, and, this dispersion communicates a white color to the milk.

* * * * * * * * * *

As to the casein, a portion of it is probably comprised in the coverings of the butter globules; the greater part of it, however, exists in solution in combination with the soda. The milk-sugar is simply dissolved; it

is not very sweet compared with ordinary sugar, although it gives the sweetness peculiar to fresh milk. Its great characteristic is the facility with which it is converted into lactic acid, which serves a most important part in the production of the butter, as will presently be seen. This transformation of the milk sugar is excited by the incipient decomposition of the casein.

When milk is set away at ordinary temperatures the butter globules rise to the top, and constitute the cream. At from 55° to 59° milk is more limpid than when of a lower temperature, and the cream rises more readily. If made warmer than 59° incipient decomposition of the free casein is unduly hastened; this causes the premature conversion of the sugar into lactic acid. The acid neutralizes the soda that holds in combination the bulk of the casein and causes the latter to coagulate, and this thickening of the milk prevents the further rising of the cream. The best results are said to be attained when the milk has a depth of from one and a half to two inches in the pans. Zinc pans possess the curious property of retarding the souring of milk from four to five hours as compared with that kept in tin or wooden vessels. In the absence of definite knowledge upon the matter the reason of this may be inferred to be that the lactic acid first formed is neutralized by combination with the basic oxide on the surface of the metal. The use of zinc for this purpose is, however, highly reprehensible, because the salts of zinc are poisonous in a high degree, and cases have been known where persons who have used butter made from milk kept in zinc vessels have suffered severe and nauseating attacks from this cause. Glass and tin, which are practically incorrosive, and wood, when kept perfectly clean, are the best materials for vessels in which milk or cream is to be held.

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Air being admitted to the milk or cream while being agitated, the oxygen acts upon the milk sugar, and changes it into lactic acid, which, as previously explained, coagulates the casein in clots, such as are seen in the buttermilk, and acts indirectly to facilitate the rupture of the globules. As a matter of curiosity, it may be mentioned that butter may be churned from milk in the entire absence of air, but the process is more tedious. Some years ago somebody invented a method of churning in which he proposed to pump the air all out of the milk, under the belief that the globules would swell up and burst of themselves. But it is needless to say it failed to meet his expectations. The warmer the milk or cream the more readily will the sacs or coverings of the butter globules break; but on the other hand, the higher the temperature the softer the product, and the more difficult to make it hard and firm by working. When the cream is too cold the churning process is interminable, and there is some reason to suppose that the butter will not "come" until the whole has been brought to the requisite degree of warmth, in the absence of other means, by the heat generated in the churning operation; it being a well-known fact that in the process ordinarily carried on cream rises in temperature about ten degrees from the commencement to the end of the churning. Fifty-eight degrees has been settled upon as the proper temperature at which to commence churning, but it may be somewhat lower in Summer and two or three degrees higher in the cooler Autumn months.

* * * * * * * * * * *

The yellow color of butter is dependent upon the nature of the food of the animal, and is deeper in proportion to the richness of the pasture. Sometimes artificial coloring is resorted to, annatto being the material commonly used, although in rare instances the juice of carrots is used as an inferior substitute.

The butter having been properly worked and salted in the usual manner, needs only to be placed in good oak receptacles, and kept covered with clear brine, in order to remain good for an indefinite period. With regard to the packing; several forms of tubs have been patented from time to time, but whether they possess any advantages over the ordinary firkin is doubtful. One of those patented a few years since had a central orifice formed in the bottom, and upon the latter a false bottom was placed, the orifice being stopped with a plug. When it was desired to remove the butter from the tub the plug was removed, the tub inverted, and the whole forced out by a stick inserted through the orifice, and pressing against the false bottom. In another the alleged improvements consisted simply in coating the inside of the tub with paraffine, which is impervious to brine and water.

[Considering the properties of paraffine, it is obviously entirely unadapted to any such purpose as this, as it not only shrinks largely and cracks (on a surface coated with it) during its passage from a liquid to a solid form, but, even after solidification it continues slowly to decrease in bulk, its crystallized molecules being apparently in a condition of expansive tension. Professor B. SILLIMAN has a crystalline block of paraffine which exhibits the distortion from an original parallelopiped shape, arising from such gradual shrinkage, to a most surprising degree. Moreover, if it is supposed that the impregnation of ordinary dry wood with melted paraffine will prevent the further shrinkage of the wood itself, and consequent opening of the seams of the keg, in a desiccating atmosphere; this will also be found to be a delusion.

It is now several years since the undersigned, considering in every aspect this highly important question of the preservation of butter, devised and carried out certain methods of preparing butter kegs and firkins, so as to fulfill all the requisites of preservation of the contents. These requisites are: 1. Perfect impermeability to atmospheric oxygen on the part of the wood. 2. Absolute prevention of shrinkage of the wood in lapse of time. 3. The use of innocuous materials. The method discovered to accomplish all these requisitions consisted in the impregnation of the wood of the keg or firkin, by certain manipulations, with a solution of *chloride of calcium*. Wood so prepared is impermeable to air, and never changes its bulk; and the liquid is not only innocuous but highly antiseptic, more so than brine. Details may be given on another occasion, should this preliminary notice attract the attention which it merits from those interested in the packing and preservation of butter, lard, etc. HENRY WURTZ.]

One more interesting paragraph from Professor WHITNEY:

"The liability of butter to turn rancid, and the objection in some regions to the use of salt as a preservative agent, has led to the use of other means of preparation which change somewhat the character of the article, and thus produce what may also be properly termed distinct kinds of butter. Of these is the butter brought to Constantinople from the Crimea and the Kurban on the shores of the Black Sea. This is kept sweet by the following treatment. It is melted over a slow fire, the scum is skimmed off and a little salt is mixed with it. Butter thus prepared, it is said, may be kept for two years without the slightest change. The chemist THENARD recommends a similar plan with the entire omission of the salt."

## The Stars a Source of Heat.

Strange as it may seem, the stars furnish the earth an appreciable amount of heat. The London *News* in an article on the subject, says:

"Mr. Huggins has just published the results of a series of inquiries addressed to the actual measurement of the heat which we receive from the leading brilliants of the nocturnal sky. The galvanometer was made use of in these investigations. The instrument was fixed by Mr. Huggins' large refractor, so that the image of a star formed by the eight-inch object glass might fall upon the surface of the thermopile. When the time came for making an observation, the shutter of the dome was opened, and the telescope was turned upon a part of the sky near to some bright star, but not actually under it. Then the needle was watched to determine whether the change of position had produced any effect. If, in four or five minutes, no signs of change were shown, the telescope was moved over the small distance necessary to bring the image of the star directly on the face of the pile. Almost always the needle began to move as soon as the image of the star fell upon it. The telescope was then moved slightly away again from the star; the needle was seen to return to its place. In this way from 12 to 20 observations would be made upon the same star, so that no doubt might remain as to the motion of the needle being really due to the star's heat. In this way it was found that Arcturus moved the needle three degrees in a quarter of an hour. Sodid Regulus, Pollux gave a deflection of one and a half degrees; but, singularly enough, his twin brother, Castor, produced no effect at all upon the needle. The splendid Sirius gave deflection of only two degrees; but as this star is always low down, and shines through a greater proportion of the denser atmospheric strata, it is not surprising that its heat should not be proportioned to its brilliancy."

**To Prevent the Scaling of Locomotive Boilers.**—A few pounds of metallic zinc cut into small pieces, or preferably granulated by first melting, and then pouring into water, is is said will become dissolved, and cover the inner surface of the flues of the locomotive boilers with a thin coating of zinc, and thus prevent it from scaling. If this assertion be true, it is certainly a very valuable discovery, and one which deserves the attention of every practical engineer.

## The Gas Question at Indianapolas.

REPORT OF THE INSPECTOR TO THE COUNCIL. INTERESTING FACTS AND FIGURES.

The following is the report of the City Gas Inspector made to the Council at the regular meeting, on the 14th of June. It is a document well worthy of a careful perusal:

OFFICE OF THE CITY GAS INSPECTOR,
INDIANAPOLIS, June 21, 1869.

*To the Mayor and Common Council of the City of Indianapolis:*

Gentlemen: At a regular meeting of the Council, held the 7th instant, the following motion, introduced by Mr. Kennington, was adopted:

"That the Gas Inspector be instructed to report to the Common Council in what way the office of Gas Inspector is an advantage to the tax-payers of the city; and whether the Gas Company furnish all the gas required by their contract, in lighting the street lamps."

The above motion is highly comprehenive, and will require me to set forth both what I have done and what the Council should do, when, in answering the after part of the motion, I will show that during the first contract year, the city of Indianapolis has lost between $3,000 and $4,000 in light and gas upon the streets by the variable pressure in the street mains; that the private consumer wastes gas from the same reason; that there is no necessity for a pressure exceeding fifteen-tenths in so level a town as this; that meters are inaccurate, by whom they should be tested and who should foot the bills, etc.

In this communication, I can only report "in what way the office of gas inspector *has been* an advantage to the tax-payers of the city;" and to do this intelligibly it will be necessary for me to go back a few years in the history of the so-called "Gas Controversy;" and to say, in as few words as possible, the circumstances which render it important and necessary that the city should provide itself with an officer, whose sole charge would be to guard her and her tax payers against wrong and imposition, save to the treasury thousands of dollars, lighten the burden of taxation, and assure more just treatment and better satisfaction, both public and private, than is usually obtained from the "most soulless of all soulless corporations—a gas company.

The first charter of the Indianapolis Gas Light and Coke Company was granted for fifteen years from March 4th, 1851; and early in 1865, that corporation was seeking a continuance of its existance, through a second charter. In response to an advertisment of the city clerk, said company proposed to furnish at $3 48 per 1,000 cubic feet, exclusive of the Government tax of 20 cents per 1,000 cubic feet, city and citizens to pay alike. While this proposition was before the Council, a special committee on gas, consisting of Mayor Caven and Councilmen Kappes and Brown, made an elaborate report, on the 9th of October, 1865, in which they state that, under the old charter, then still existing, "the city pays for street lamps about $2 37, the citizens $4 50 per 1,000 feet, exclusive of the Government tax:" and finally recommend an extension of the grant for fifteen years (twenty years were proposed and asked for) at "$2 40 per 1,000 feet for street lamps and public buildings; private consumers to pay $3 00 per 1,000 feet, the consumers to pay the Government tax."

March 5th, 1866, Mr. R. B Catherwood, the builder of our Street Railways, offered to organize a company that would furnish gas at a rate not to exceed $3 per 1,00 cubic feet, and that the net earnings, after paying fifteen per cent. upon the capital invested, shall be divided between the Company and the city equally." General ordinance No. 41—1865, based upon the proposals of Mr. Catherwood, was reported to the Council by Mayor Caven and Mr. Kappes, on the 12th of March; and the same evening, Mr. Brown accompanied his minority report with general ordinance No 42—1865. On the 9th of March both ordinance passed their second reading, and No. 42 (which is the present charter) was amended and finally adopted by a vote of 11 to 5.

In the report of the Special Committee on Gas, spoken of above, and submitted October 9th, 1865, the gentlemen composing it indulge in strong criticisms upon the monopolizing and dictatorial spirit of Gas Companies generally, and of that of the Indianapolis Gas Light and Coke Company in particular, giving valuable figures, facts and comparisons, as then existing in and between this and other cities of the country. It is in said report that the first mention is made of the creation of the office of City Gas Inspector. As the committee suggest some matters not embraced in the ordinance under which I am now acting (General Ordinance No. 122—1868), and as they seemed to entertain a high opinion of the importance and necessity of such an office, I will quote their language:

"The Committee would further recommend the appointment of a Gas Inspector, whose duty it will be to see to the quality of the gas, the accuracy of the meters, the propriety of the erection (proper erection ?) of street lamps, and that they are properly lighted, extinguished and repaired, and, indeed, a general supervision of the whole subject. He shall, as soon as practicable, prepare a chart and register, showing the lines of mains, their size, and also the location of lamp posts, and shall keep the same carefully perfected as additions are made. There should be two copies, and kept in different places, so that both would not likely be destroyed by any one ordinary casuality. *He shall have free access to the books and accounts of the Company; to be present at the meetings of their Directors, keep an account of the receipts and expenses of the Company, and report to the Council from time to time.*

"The Council should pay him a responsible salary, sufficient to secure a competent and faithful man. *The city can afford to pay an officer a fair salary for fifteen years*, by means of whom they will be able to obtain, when they come to renew, such full and accurate information as will enable them to make a new arrangement with a perfect understanding of the subject. The question of light for a large city is one too important to be in the dark upon. We should understand it thoroughly.

February 18th, 1867, another Select Committee on Gas, consisting of Councilmen Grosvener, MacArthur and Coburn, make a lengthy report upon test of gas burners in use in the public lamps; expose sundry gas "tricks of trade;" show an overcharge in the Gas Company's bills for sixteen lamps, and state they are satisfied that this error has existed for several months, and may have been for several years; and, towards the latter part of their report, make the following recommendations:

"We would reccommend the appointment of an Inspector and Superintendent of Gas, who shall be paid a salary of $——— per year, who should have the entire control of all gas lights; light and extinguish all the meter lamps as per time table; see to the erection of new lamp posts; test all burners; that the quality of the gas furnished the city, the correctness of the gas meters, &c. The city should furnish and own a complete apparatus for making these tests."

The same evening, Mr. MacArthur moved to elect a Gas Inspector, to serve from the first of May next, which was "laid upon the table for the present."

The suggestion of overcharge on sixteen lamps was subsequently refered to the Committee on Finance, who on the 27th of May, report a "Memorandum of the settlement between the city of Indianapolis and the Indianapolis Gas Light and Coke Company, on account of overcharges for *eighteen* lamps from October 1, 1866, to February 1, 1867."

December 16, 1867, Mr. Geisel offered the following motion, which was refered to the Committee on Gas:

"That the City Council take some action in regard to the appointment of a Gas Inspector for the city."

January 6th, 1868, the Committee on Gas reported "that they do not deem it expedient to make the appointment at this time, and refer the whole matter back to the Council for your consideration." When Mr. Brown offered the following motion, which was adopted:

"That the subject be referred to the Committee on Revision of Ordinances, with instructions to prepare and report an ordinance creating the office of Gas Inspector, defining his duties, and fixing his salary, and the manner of fixing the same."

February 3d, the named committee reported the existing ordinance; which was amended on the second reading (Feb. 17), and then passed by the vote of 14 Councilmen in the affirmative, Mr. Cottrell only voting in the negative. On the latter evening, I was elected as the first incumbent of the newly created office.

On assuming charge of gas matters, as agent for the city and the private consumers, I found that the public lamps with the exception of those on Washington street and in East Market house, were only burned until 12 o'clock midnight, under action of the Council, had January 20th, 1868; and was made aware, by frequent communications and petitions, sent to the Council, that this system was not pleasing to the public.

March 9th and April 6th I pointed out to the Council, by official communications, the excessive over-register of the four meter lamps used for averaging the consumption of gas used by the street lamps, in which I declared such a system of estimating unjust, and recommended the doing away with meter lamps, and the employment of burners tested to pass four cubic feet per hour.

On the 13th of April the Committee on Accounts and Claims reported their concurrence with my figures and recommendations, advised drawbacks for February and March, aggregating $152 72 for excess of consumption by 102 lamps, which had been provided with tested four feet burners, and also insisted upon the doing away with "estimating" by meters.

This report was concurred in by the Council, and subsequently Messrs. Jameson, Woodburn and Seidenstickerwere appointed a special committee to confer with the gas company, secure the abolishing of meter measurement to the lamps, etc. I was present at all the meetings of this committee and the officers of the Gas Company, revised or prepared the correspondence in its behalf, and was present with the City Attorney when he was writing the contract that now exists between the City and Company, which was adopted May 4, 1868.

Prior to the commencing under the new contract, by direction of the council, I had cut off eighty-seven of the old lamps, thus reducing each square in the city to a maximum of four lamps, and saving, under the contract, $2,610.

To go back a little: January 6th, 1868, Mr H. Stacey, Superintendent of the Gas Light and Coke Company, filed with the city Council, accompanied by a lengthy communication on moonlight, twilight, etc., (for which see page 649, Proceedings Common Council 1867 and 1868; and, with the exception of the two lines at the commencement and the signature at the end, I would refer the Council, *for every word and figure*, to the American Meter Company's Gas Engineers' and Superintendents' Pocket Almanacs, since 1865), a time table for the public lamps for that year, with an aggregate schedule of 2,319 hours.

The Gas Company's bill for December, 1866, named the number of public lamps at 847, and 37 were "erected" during the year 1868, making a total of 884 at the end of year, had no change been made. I will assume that 860 would have been the average number burned during the entire year. In January, 1868, an average consumption per hour per lamp, according to the Gas Company's bills, as shown in my communications above mentioned, was 6.86 cubic feet per hour, in February, 6 36; in March, 7.15, and in April, 6 95; the average for the four months is 6 58 cubic feet per hour. The cost of lighting and extinguishing was then 35 cts. per month per lamp. The estimated cost of repairs and materials for lamps, according to bills paid in former years is one dollar per lamp per annum.

Using the above figures as just data (and they are well within bounds,) the cost of the public gas, Government tax on same, lighting and extinguishing, and repairs and materials, under Mr. Stacey's time table for the calender year 1868, would have been $47,818 32. And since seven lamps have been added during the month of April last past, it may be safely assumed that, without change of circumstances from those existing in January, 1868, the cost of the public gas, ect., from May 1, 1868, to April 30, 1869, would have been considerably upwards of $48,000.

From May 1, 1868, to April 30, 1869, the following figures have prevailed, under the new contract: Gas furnished at the rate of $24 per annum per lamp (four feet per hour on a time table of 2,000 hours), and $6 per annum was paid per lamp for lighting, extinguishing, and repairs. The aggregate bill of the Gas Company for the above period amounts to $23 678 30.

Deducting from $48,000 the some of $23 678 30, and the saving effected shown to be $24, 321 70.

There are items that go to make up the above saving allowed by the gas company without the publicity of my officially communicating the same to the Council would have involving; for instance, they agreed to a drawback of $64 53 for lamps not lighted in December, 1868, &c., amounting to, probably, between $100, and $200.

Again: By the report of the Committee on Accounts and Claims (April 13th, 1868) and which was written by myself, drawbacks aggregating $152 72, were made from the February and March bills.

I, therefore, submit that it is to me, primarily, and to the office of the City Gas Inspector, created by your predecessors, that the taxpayers of Indianapolis are indebted for a saving of about $25,000 of taxation between the 17th of February, 1868, and the 30th of April 1869.

That I have been able to do scarcely any thing for private consumers, except through the healthy influence of regular photometric test of the candle power of the gas, whereby they have been receiving a better quality of that article than was ever before furnished in Indianapolis, was a fault of a party in the former council, the presistent labors and peculiar influence of the Gas Company, and the rabid and untruthful attacks made against the office by vilifying the officer, which led me, at an early day of my second term, to cease all efforts through the Council. I however, think, that, by what I was able to and did do, I well earned the paltry reward of $651, which was the aggregate of my salary and perquisites from May 1st, 1868, to April 30th, 1869, having been compelled to pay $50 for instructions in the duties of my office, and fully $50 more for traveling expenses, improvements in my apparatus, &c., for which no bill has ever been presented against the city.

It is within your power, gentlemen, to make the office of great value to both city and citizens, and yet impose no wrong upon the gas company. How this is to be done, will be found in my answer to the second inquiry contained in Mr. Kennington's motion, and which I will be ready to submit next Monday night.

GEORGE H. FLEMING,
City Gas Inspector.

# Correspondence.

[Correspondents in all cases should sign their communications with their names and address in full, not necessarily for publication, but as a guarantee of good faith.—EDS.]

## About Water Filters.

SILICATED CARBON FILTER COMPANY,
CHURCH ROAD, BATTERSEA,
LONDON, S. W., July 13, 1869.

Messrs. Editors; Our attention has been drawn to an article in your Journal of 16th June, on Water Filters, extracted from the *American Artisan*, and as we understand the article, it seems exactly to describe the filters patented by the late Mr. Dahlké, of which we have been for many years the sole manufacturers.

Allusion is also made to a filter of French invention, claiming to possess extraordinary power of both mechanical and chemical filtration; but we may mention, that at the International Exhibition at Havre in 1868, our filters carried off the silver medal, to the exclusion of the French and all other kinds.

The material of which our filters are composed is pure carbon, mixed with finely divided silica; and we have ample evidence from medical men, scientific chemists, and practical men of all grades, that this combination is the best known for depriving water not only of the impurities mechanically suspended in it, but also of the organic matters held in solution. Using this material made into porous slabs, we have manufactured many thousands of the small pocket filters for travellers (as described in your article), as well as syphon filters for cisterns; domestic filters of various patterns and sizes, and large main-service filters for manufactories, public buildings, hospitals, etc.; and we have never yet found a natural water (except sea water) which could not be rendered wholesome, sweet and drinkable, by our method of filtration.

We may also mention that we have been in communication with Mr. C. F. A. Henrichs of New York, respecting the application of our filtering medium to the outlet cocks for the supply of dwelling-houses, in such a manner that the apparatus may be easily reversed, and all the impurities carried away, by allowing the water to pass through in the opposite direction.

We are, yours truly,
THE SILICATED CARBON FILTER CO.

## Obstructions in Gasholders.

NEW ALBANY, July 22, 1869.

Messrs. Editors: Finding our inlet to holder partially obstructed, I resolved to remove the difficulty by getting 100 gallons of boiling water in order. I then stopped our bench of retorts at work, turned the gas off from city at 5 o'clock, A. M., removed the nuts from bonnet of holder, opened stop-cock and let what gas we had within blow off; quickly the holder found its resting place on the bottom. I then drove a chisel between bonnet and holder, gently lifting one side of it, which made the gas escape nicely; but I very soon found out that the dome-like appearance of our roof was becoming flat. A loud convulsive shock, and two or three squares assumed a collapse shape, and your humble servant in deep trouble; believing that if the roof was not trussed there certainly would be frame work within to support the same when empty; but alas! no such provision had been made. I hastily removed the chisel leaving the bonnet down, when all became quiet, and upon strict examination I found that although the roof had assumed an inverted shape yet all appeared sound. I resolved once more to lift one side of bonnet, allowing the gas to escape at the rate of about 30 feet per minute; all was well for three or four minutes. But such a shock—still sinking; things began to look mighty billious. I thought of a gas works without a holder, and a city in darkness. Quickly stopping the flow of gas to take one more breathing spell and examine. I still found all apparently sound, there not being much more gas left. I once more lift side of bonnet and let all the gas off; the holder now instead of its dome-like shape, had the appearance of a huge wash basin, the centre being about four feet below its

original position; yet nothing appeared strained, having no steam. I then poured in two or three buckets of boiling water and the trouble was removed: all found its way to dip well. I then put on bonnet and bolt it down. The time from starting to let the gas off from holder was about one and a half hour. On charging our bench the roof rose gently, and by 9 o'clock, A. M., it once more assumed its original dome-like appearance, and nothing the worse of trip. It is eighteen years in use; is 50 feet diameter and 16 feet deep, and from present appearance it does seem as if it will last two 18's more.

Respectfully,

T. DUNBAR.

P. S.—In my report, June 8th, for 500 lbs. plastic slate, it should read 400 lbs. per barrel, that being the amount required for our tar. T. D.

### Easton (Pa.) Gas Works.

EASTON, PA., July 14, 1869.

Messrs. Editors: As you have not heard from us a few lines from our works may not be out of place. We have about 800 consumers and 100 street lamps. The largest amount of gas consumed in twenty-four hours is 47,000 cubic feet. We have always used iron retorts until February last. We set up one bench clays, five retorts, with which we are making all the gas we want at present. We use 4500 tons of coal and make 21,000 feet over four and six-tenth per pound; but we have one of McKenzie's Patent Gas Exhausters, without which we could not very well get along. The engine and boiler, exhaust and governor is the most complete arrangement I have ever seen. We use the heat from retorts to generate steam; it passes through the flue then around the boiler before it reaches the chimney. Before we had this arrangement we used about 140 bushels coke per week, for which we can find ready sale at eight cents per bushel, so that is a saving of nearly $600 per year. Wherever they can run an exhauster as cheap as that it would be foolish to have clay retorts without it. The governor for steam engine I consider the best in use. It is one of my own invention, and is a perfectly reliable machine. The loss on street mains last year was about 12 per cent. If you consider this of any importance you will please give it place in your valuable Journal.

Respectfully yours,

SAMUEL TRUMBORE,

Sup't Easton Gas Works, Pa,

[The idea of using the waste heat of the benches to generate steam for the engine which operates the exhauster seems to be novel, and worthy of imitation.—EDS.]

### Density of Water.

TIFFIN, O., July 24, 1869.

Messrs. Editors; I see in your issue of 16th ult, an article asking information as to the density of water at great depths, etc. I would call your attention to an article in the *American Artisan* of 6th July on "Water not yet Understood," and same paper of July 28th on "Deep Sea Soundings"; therein the subject matter is treated. Or if you think the subject of sufficient importance to your readers, I would respectfully ask you to reprint the same.

I am gratified to find you fully restored to your "old sore" (gas), making it the primary interest of your Journal, as shown by your new and very appropriate heading. Also to find the gas fraternity "exercised" about the Cincinnati explosion, and hope it may be the means of scattering the cloud of mystery with which it *seems* at present veiled; though how our friend of Madison, Ind., can reason out a "collapse," I should very much like to know. Mr. Rankin's theory has more plausibility in it, although I believe any explosion on top sufficient to depress the gasholder *at all*, would have driven the crown right in, which perhaps is the meaning of "collapse," *for he leaves us to guess* at his meaning.

I entirely agree with "E" of Fort Wayne, that a prize should be awarded on the solution of the problem propounded. Let gas engineers throw some light on the subject.

Yours truly,

MACHINIST.

### The World Moves.

Every great event should be recorded in the memory of even the man of details; for every great event prepares incalculable shifting of interests, national and individual, to which the position of him who fancies himself most isolated and independent must, perforce, sooner or later, conform. This is a century of historical cataclysms. Every year brings some fresh commotion. Mankind, losing its loosely aggregated fluid condition of life and growing compact and solid, begins to move massively. The quick and general distribution of information now makes the mutual consent of millions to a project, to a reform, as easy and simple an act as the alliance of two royal cabinets used to be—in fact simpler and easier. A whole empire now votes for or against a man, or a measure; and the vote so cast is two overwhelming to be resisted. A whole empire supports an emancipation proclamation, and in a moment the face of history changes for an entire race. It is the age of enthusiasms, sustained and re-inforced by money, machinery, electricity, steam and the democratic caucus system. The Pacific Railroad in one quarter of the globe, the Suez Canal in another, Napoleonism reversed, Bourbonism overthrown, mark the eventful year. Now the news is flashed from St. Petersburg across Europe and through the ocean, that the ecclesiastical establishment of Russia has been quietly set aside by a ukase of the Emperor. Hereditary is priesthood abolished. A vast section of the original world has been suddenly accidentalized, and without commotion; scrcely a passing remark about it in the newspapers. Stunned by the recent abolition of serfdom, the nation looks on passively while the status of seven hundred thousand men, women and children, belonging to the sacerdotal order, is changed at a nod. It is the act of emancipation. The son of a priest no longer need become a priest. It is a fresh step towards the education of the whole people in a higher way. It must affect trade, agriculture, manufactures, commerce, science and politics. It has an indirect bearing upon the future movements of Russia, eastward and southward, and perhaps westward. In any case it is one of the great events of the year, and deserves its chronicle. —*Exchange.*

### The Petroleum Wells.

The Titusville *Herald* says: "Late accounts from West Virginia shows a production of but about five hundred barrels per day at the outside, which, compared with our last report of it, shows a further falling off of two hundred barrels a day. The estimate of the product at all the producing points is as under:

| | |
|---|---|
| Oil Rock, per day, barrels | 40 |
| Burning Spring, per day, barrels | 250 |
| White Oak or Volcano, per day, barrels | 160 |
| Sand Hill, per day, barrels | 60 |
| Total, per day, barrels | 500 |

"Of the above product about two hundred barrels is heavy oil. There are three new wells going down at Burning Springs. In Ohio the product is about 400 barrels a day.

"The production at Parker's Landing, on the Allegheny river, seventy miles north of Titusville, has increased during the past month, and the daily average is now three hundred and ten barrels. The average daily product of the wells is twelve and three-eighths barrels. There are forty leases taken, and the development is being pushed forward vigorously.

"A new well on the Niagara Petroleum Company's track, Cherrytree run, which was struck recently, is now yielding eight barrels per day and increasing. The product of this track for the twenty-four hours ending at noon yesterday was three hundred barrels."

**Death of Professor Nickles.**—We learn from a short notice in the *Moniteur Belge* of the 14th April, says the *Chemical News*, that Professor Nickles, of the Faculty of Sciences of Nancy, Department de la Meurthe, France, has died suddenly, in consequence of accidentally inhaling, as it appears, the vapor of concentrated hydrofluoric acid, while engaged in making experiments to isolate fluorine. The deceased was born at Erstein (Bas-Rhin) on the 30th of October, 1820, was appointed in 1854 to the Professorship he held, and in 1857 was made corresponding member of the Council General of Public Instruction. The printed list of his many and valuable published scientific works occupies a complete page in the well known *Biographisch-Literarisches Handworterbuch zur Geschichte der exacten Wissenschaften.*

### The Age of Our Earth.

Among the astounding discoveries of science, is that of the immense periods that have passed in the gradual formation of the earth. So vast were the cycles of the time preceding even the appearance of man on the surface of our globe, that our own period seems as yesterday when compared with the epochs that have gone before it. Had we only the evidence of the deposits of rocks heaped on each other in regular strata by the slow accumulation of materials, they alone would convince us of the long and slow maturing of God's works on earth; but when we add to these the successive population of whose life the world has been the theatre, and whose remains are hidden in the rocks into which the mud, or sand, or soil of whatever kind on which they lived, has hardened in the course of time—or the enormous chains of mountains whose upheaval divided these periods of quiet accumulation by great convulsions—or the changes of a different nature in the configurations of our globe, as the sinking of lands beneath the ocean, or the gradual rising of continents and islands above—or the slow growth of the coral reefs, those wonderful sea walks, raised by the little ocean architects, whose own bodies furnish both the building stones and the cement that binds them together, and who worked so busily during the long centuries that there are extensive countries, mountain chains, islands and long lines of coast, consisting solely of their remains—or the countless forests that have grown up, flourished and decayed, to fill the storehouse of coal that feeds the fires of the human race—if we consider all these records of the past, the intellect fails to grasp a chronology of which our experience furnishes no data, and time that lies behind us seems as much an eternity to our conception as the future that stretches indefinitely before us.—AGASSIZ.

**Utilising Waste Steam from Cylihders.**—The invention of Mr. Robert Meldrum, of Bittormie, Scotland, for the utilisation of the waste steam which has done its work in the cylinder without condensing it with cold water, consists of a chamber or chambers (which latter are connected with each other by proper openings) in which fans are mounted, and from which, as well as the boiler cylinder and parts in connection therewith, common air has been extracted, either through displacement or by an air pump. The steam when allowed to bear on these fans, owing to their position, will drive them round at a very great speed, but in accordance with the power of the steam, and there being a sufficiency of the above, the steam will in its progress lose its power until it has none; or, in other words, be received into a vacuum. These chambers by their proper ducts will receive the condensed steam, from which, or other suitable place, it may be pumped back to the boiler, thus forming a continuous revolution of the motive power. The fans hereinbefore eescribed should be made to fit closely at the top and sides of the chambers. The openings communicating between one chamber and another he prefers to make as one large orifice at the top for the steam, and a smaller one at the bottom for any water formed to pass through, and in the first chamber this bottom orifice should be very small, in order that as little steam as possible may pass through it. In succeeding chambers the holes may increase in size according to the size requisite for removing the water formed. There may be sets of chambers ranged in order side by side, or otherwise, which may be connected by tubing, according to requirement for condensation.

**The Portable Gas Light.**—An ingenious but simple invention, patented by T. Ward, is being made by the Portable Gas-Light Company, at 108 N. 5th street, St. Lous, Mo.; is cheap, brilliant and safe; a world of trouble is saved and convenience afforded; is only second to coal gas, and in brilliancy is superior to any other. It consists of a fluid that is non-explosive when put into metallic lamps, lanterns, brackets, swing lamps and chandeliers of any size or pattern, and to all appearances becomes a gas light, dispensing with mertering, piping, or mains as needed for coal gas, as every burner generates its own gas as fast as needed, at a much less cost than carbon oil, being in every respect as safe as the old tallow candle. When being carried from place to place is not easily blown out, and when left to burn all night, if by any accident the flame becomes extinguished, there is no gaseous substance escaping to endanger the life of persons near it, and unlike kerosene, if spilled, will not form a combustion, but can be poured upon a sheet of paper and consumed without scorching the paper, leaving no grease or oily substance to remain indelible. This light is being used for lighting offices, stores, residences, halls, churches, streets and parks, at a trifling expense compared with coal gas or kerosene. Any one desiring statistical and certified information, can secure same by addressing Messrs. Botsford & Massey, St. Louis, Mo.—*Commercial Review and Railroad Journal.*

### Effect of "a Little Oxygen."

The coldness and tenacity of purpose shown by Professor Bunsen, under disconcerting circumstances, reminds the Worcester *Spy* of a display of similar qualities under a similar test, by the late Professor Silliman at New Haven:

In one of his lectures, Mr. Silliman was explaining the properties of hydrogen, and was proceeding to illustrate its combustible properties by an experiment. After stating that, on a lighted candle being applied to it, it would burn quietly with a bluish flame, he raised by its knob a glass receiver which he supposed was filled with the gas, and applied the candle. There was a violent explosion; the glass flew in splinters about the lecture room; the ladies present screamed with terror, and the students rose from their seats, startled by the shock, and uncertain whether some of the other powerful agents in the laboratory might not be called into destructive activity in a moment. The cool bearing of the venerable professor, as he stood in an easy attitude, still holding the knob of the jar in his hand, quieted the apprehensions of the audience, and, as soon as the commotion began to subside, the clear, even tones of his voice were heard saying: "This illustrates something I was going to speak of by-and-by. A little oxygen was accidently mixed with the hydrogen, and caused the explosion. It has burned my hand a little, but that's no matter. We will now try another jar, which I presume we shall find more pure."

### Prices of Gas Coals—August 2.

PROVINCIAL.

| Duty, $1 25 | Coarse. Gold. | Slack. Gold. |
|---|---|---|
| Block House | $1 75 | $0 75 |
| Gowrie | 1 75 | 0 75 |
| Lingan | 1 75 | 0 75 |
| Sydney | 2 13¾ | 0 71¼ |
| Pictou (Albion) | 2 13¾ | 1 18¾ |
| Pictou (Acadia) | 2 00 | 1 00 |
| Little Glace Bay | 1 50 | 1 00 |
| Caledonia | 1 50 | 0 75 |
| International Co.'s Union Mines | 1 60 | 0 75 |

Free on board vessels at the mines—payable in gold.

AMERICAN.

| | Coarse. Currency. | Slack. Currency. |
|---|---|---|
| Westmoreland Co. | $8 75 | $0 00 |
| Despard Coal Co. | 8 50 | 8 00 |
| Penn | 0 00 | 0 00 |
| Newburgh Orrel Gas | 8 50 | 8 00 |
| Wet Fairmount Gas Coal | | 8 00 |
| Powelton Gas Coal | 8 00 | 7 00 |

Delivered in New York.

PRICES OF FOREIGN COALS—DUTY $1.25 PER TON.

| | |
|---|---|
| Liverpool Gas Caking | $ 9 50 |
| " Cannel | 14 00 |
| " House Cannel | 18 00@19 00 |
| " " Orrel | 16 00@18 00 |

Per ton 2240 lbs., Ex. ship.

PRICES FROM YARD.

| | |
|---|---|
| Liverpool House Orrel, scr'd | $16 @ $18 |
| " Cannel, scr'd | 18@$20 |

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AND

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EDITORS AND PROPRIETORS.

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Geologist and General Scientist,
PROFESSOR HENRY WURTZ.

[NOTE BY PROFESSOR WURTZ.—Contributions and items for which I am, as a Scientist, individually responsible, will have attached my full name or initials.—H. W.]

MONDAY, AUGUST 2, 1869.

WISHING TO MAKE this Journal an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of those subjects a pleasure, or a profession.

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## ON VENTILATION.

We have on several occasions written articles on the subject of proper ventilation in all public buildings, and urged the necessity of a speedy reform. We again bring it before the public, in the hope that those who are erecting other public or private buildings will see to having a proper method of ventilation carried out. The generalization of the baneful influences of a vitiated air must, as a matter of course, be admitted; but the urgency to remedy its immediate and proximate consequences has only been addressed to one section of citizens. Let us now turn our attention to another section—the section of the poor and destitute—foeted exhalations and emanations from whose dwellings are at times unbearable, the fevers and other cautagious diseases arising from them find their way into the dwellings of their more fortunate neighbors. The miasma of courts and alleys enters the lungs and casts the recipient on a bed of sickness. Will any rational man contend that the science and legislation of this nineteenth century should not be exerted to the necessity of a proper sanitary ventilation? Every one who has knowledge or wealth at his disposal is bound to exert some portion of them as much for the benefit of his ignorant and poorer bretheren as for his own pleasure, his profit, for it is to his own daily safety. Besides which, is there not a *moral law* requiring us to do so? Is there not also a *natural law?* There are both these laws, and they have this distinguishing proof of their divine origin, they are self-acting; they confer the reward of obedidence, and they inflict the penalty of transgression, with a precision and certainty which find no parrelled in mere human laws and institutions.

On a general muster of the buildings on which the architect has lavished all his art and skill, for the most part they are entirely destitute of *special* means for ventilation, and are so constructed as to now render the application of such means extremely difficult in many cases. Such a contrivance nearly forms a part of a contract. A building capable of containing eight hundred to a thousand persons, whether it be a church, a lecture room, an assembly room, a concert room, or a school, is in consequence of this neglect, the too frequent scenes of much painful suffering. When such a room is crowded, the consequences are sufficiently marked; either such a multitude must be subjected to all the contaminating evils of an unwholesome atmosphere, or they must be partially relieved by opening the windows and allowing a continued stream of cold air to pour down on the heated bodies of those who are near them, till the latter are thoroughly chilled, and probably fatal illness is induced. This would never be had either the architect or his employers known the laws of the human constitution.

School rooms also are sadly defective in respect to ventilation. When the whether did not admit of open windows, the atmosphere of the room was most unwholesome. Command of temper on the part of the teachers, and mental progress on the part of the pupils, was, of course, next to impossible under such circumstances. We would take it upon ourselves to appeal to the experience of teachers in general, whether the slow comprehension and listlessness of children in school, who are sharp, smart, and clever in the play ground, may not be traceable in a great measure to the viliated air which they are compelled to inhale?

Theatres are for the most part tolerably well ventilated, or at least some attempts has been made to procure ventilation, of which the managers do not fail to make the most of in their announcement at the opening of their season. *They are practical men*; they know that for some years the attention of the public has been directed to the subject of ventilation, and that a studious attention to the comfort of the house is as likely to bring people to it as attractive performances. Some of the methods of ventilating theatres are clever and efficient, and perhaps could be applied to those highly important buildings, the church, the lecture room and the school. We shall take up this subject on some future occasion, and select a few of the best attempts on proper ventilation in other countries.

## THE HORSFORD INVENTION.

UNITED STATES CIRCUIT COURT, *Southern District of New York. In Equity:* The RUMFORD CHEMICAL WORKS *vs.* JOHN E. LAUER. This, in a chemical point of view, has been deemed one of the *causes celebrès* of the day, involving as we have supposed, the right of our distinguished American chemist HORSFORD to the exclusive use of his capital invention of the substitution of phosphoric acid, and acid phosphates, for tartaric acid, in the raising of bread etc. A fortnight since, we, and doubtless many others, were surprised to hear that a decision had been rendered adverse to Professor HORSFORD. On perusing a copy of said decision, however, our supprise is relieved by finding after all it does not touch the main question, and as it stands to all intents and purposes, amounts to a decision in HORSFORD's favor.

His *first* claim was to a specially described "article of manufacture," or 'composition of matter," a thing so easily evaded and quibbled over that it is simply absurd to enter any such claim; except as a subordinate one, which it appears here to be. His *second* reads for the special method of manufacture *for the purpose described;* his *third* for the *new use* of the special article; and his *fourth*, broadly and unconditionally, for the *new use* of phosphoric acid, and acid phosphates, in the preparation of farinaceous food. The curious decision we have here, is simply to the effect that the defendant—inasmuch as his article of manufacture is not *identical* with that of HORSFORD, (though it *is* an acid phosphate), and as his method of preparation of the article is not the same (though the article is equivalent, adapted, sold, and used, for the same purposes)—has not infringed upon HORSFORD's 1st and 2nd claims. It is stated that "the third and fourth claims of the plaintiff's patent are not involved in the case." Here is where the present writer, though not a legal person, cannot help entering a diffident protest. If the first two claims have any import, they are subordinate to the 3rd and 4th, which latter substantially specify and *include* the latter. The patentability resides in the new use, to produce a new result. The new use is that of acid phosphates, to produce the new result of raising bread without contaminating it with ingredients foreign to the human system. The utility of the result, *if it be not hurtful*, must be assumed. No proof yet appears that it is hurtful to introduce phosphate of soda into bread, though some may hold it as an hypothesis. The infringement consists in *using*, and in selling and making profit of the use of, phosphoric acid for raising bread. The unaccountable thing to us is the view that the first two claims of the patent do not really imply these rights. Could the defendant, for example, take HORSFORD's own article, mix salt or sugar with it, and sell it as a baking powder? Yet he would thus alter its chemical identity. Could he make ordinary "superphosphate of lime" (as found in commerce,) by the ordinary method; and label and sell it as a baking powder, without infringement of HORSFORD's patent? Would he not be using the same agent, with the same result? The most remarkable and ingenious ground taken by the defence, and to which the Judge, strangely to us, attaches

importance, is that BERZELIUS once prepared an acid phosphate which *might have been used* in raising bread. But was it ever used in this way? Our common sense proclaims that as a patent must be for a new utility or use, and nothing else is patentable; therefore a patent *claim* must be for a use, and can cover nothing else; otherwise the claim is naught, and should never have been entered on the Patent Records. H. W.

OUR CHEMICAL REPERTORY.—In our last New Year Issue (January 2, 1869,) we made the boast that we could give our readers "foreign scientific news in advance of any other publication." On opening a number *just received* (July 29.) of the *Chemical News* (the London edition, not the American reprint) of date July 16, we light upon an article on the *Chemical Analysis of Oil of Sassafras* which we also gave in *our* issue of July 16th! We make no empty boasts.

### EXPLOSION OF OXYHYDROGEN GAS.

The oxyhydrogen used for the oxyhydrogen lights, at Niblo's, exploded last night (August 2d) with a loud report. The gasholder was driven up through the floor above and demolished, also the pipes and connections thereto, accompanied by a considerable breakage of window glass. Fortunately the curtain was up, and the actors, etc., were in front of the scenes, else the results would have been serious.

Mr. Charles Murray, of Messrs. Ford & Murray, 13th street, operates the lights. Formerly Mr. Murray made his own oxygen in the ordinary way, but lately has obtained it from the works of the Company operating the French process of M. Tessié du Motay.

The cause of the explosion was doubtless owing to the formation of hydrogen in the highly heated retorts, by the decomposition of the steam employed to expel oxygen from the manganates, and its admixture with the oxygen. This is a contingency which is likely to prove troublesome in the future.

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## GRAHAM'S
### Patent Anti-Freezing and Drip-Receiving
## LAMP POST.

*THE BEST, CHEAPEST AND MOST DURABLE POST EVER OFFERED TO THE PUBLIC!*

**PATENTED MAY 25, 1869.**

THE GREAT ECONOMIZER OF TIME, LABOR AND EXPENSE!

*AND THE ONLY POST EVER INVENTED THAT WON'T FREEZE UP IN WINTER.*

AND APPLICABLE TO ALL OLD POSTS NOW IN USE, AT SMALL COST.

This post A is constructed with all the openings in the base B closed and made perfectly gas tight, which converts the base into a condensing chamber. The top of the post as shown in fig. 2, is fitted with a cast-iron stopper F, which is secured and leaded into the top of the post above E. This stopper is drilled and tapped to receive a short piece of pipe to which the burner cock and burner is attached. The base of the post is drilled five inches above the closed bottom to receive the service pipe, as shown proceeding from the street main C. The service pipe is made in two pieces and connected near the base of the post with a running thimble or other union; we therefore dispense with the inside upright pipe. The advantages of this improvement are manifest to all, and secures the following important ends: It prevents freezing up in any climate during the severest winters, it is not liable to choke up with dirt or water by condensation in the pipes; the gas being free from dust and impurities gives a more brilliant and beautiful light; the burners remain perfectly clean from one to two years without any attention, thereby saving eleven-twelfths of the labor and expense of keeping them clean; we save from two to three dollars worth of pipe in each post and its subsequent renewing. It requires no more attention in winter than in summer months, saving all the expense for labor in watching and protecting the lamps from freezing; the cost of alcohol or glycerine used for this purpose, and the frequent digging up of posts to thaw them out or cleaning the pipes. But to show more clearly the advantages of this improvement, we will count the actual annual cost of keeping the old lamp posts in good order; the first cost of pipe and its renewing, furnishing new burners, the frequent cleaning of the burners, cleaning the pipes, digging up posts when frozen or choked with dirt and rust in the pipes, the extra labor to prevent freezing, the cost of alcohol or glycerine used for this purpose, and we find

| | | |
|---|---|---|
| The yearly cost of each Lamp Post to be from $3 to $5; say ..... | $3 00 | |
| Therefore 100 lamps will cost in 1 year | 300 00 | |
| 10) do do 50 do | 15,000 00 | |
| Add compound int. at 6 per ct. 50 do | | $80,502 00 |
| The annual cost of keeping "Graham's Improved Post" in good order cannot exceed 20 cents per year; therefore— | | |
| 100 Lamps will cost in one year..... | 20 00 | |
| 100 do do in 50 years..... | 1000 00 | |
| Add compound interest at 6 per cent. for 50 years..... ..... | | $5,507 00 |
| Net saving on each 100 Lamps in 50 years..... ..... | | $74,995 00 |

Equal to 64.98½-100 dollars a year on each lamp.

This lamp has been thoroughly tested during the past winter, and the satisfactory results surpasses even the most sanguine expectations of the inventor.

TESTIMONIALS.

Having seen this Post tested in our city, during the past winter, and believing it to be far superior to all other lamp posts we cheerfully recommend it to all parties interested in securing a good and reliable street lamp.

WILLIAM POLAND, Pres't Chillicothe Gas Co.
WILLIAM MCKELL, " First National Bank.
L. W. FOULKE, Pres't Ross Co. National Bank.
MARTIN SCHILDER, Pres't City Council.
A. L. WADDLE, Mayor City of Chillicothe.

CHILLICOTHE, ROSS COUNTY, OHIO,
COUNCIL CHAMBER, Monday Evening, June 14, 1869.

The Committee on Gas beg leave to report, that they have thoroughly investigated the merits and operations of "Graham's Patent Street Lamp Post," and being fully convinced that it is far superior in every respect to anything of the kind ever before brought to public notice, and that it will prove to be a source of great economy to the city, we earnestly recommend a resolution authorizing Mr. Graham to apply his improvement to all lamp posts now in the city, and to all new posts that may be put up hereafter.

The foregoing is a true copy from the City Records.
RICHARD J. GARDNER, City Clerk.

(The above resolution was passed unanimously.)

State and City Rights, and Rights to Manufacture this Post, for sale in all States, except Ohio, Illinois and Michigan, which are already sold. For further information, address

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*Chillicothe, Ohio,*

Or the Editors of the
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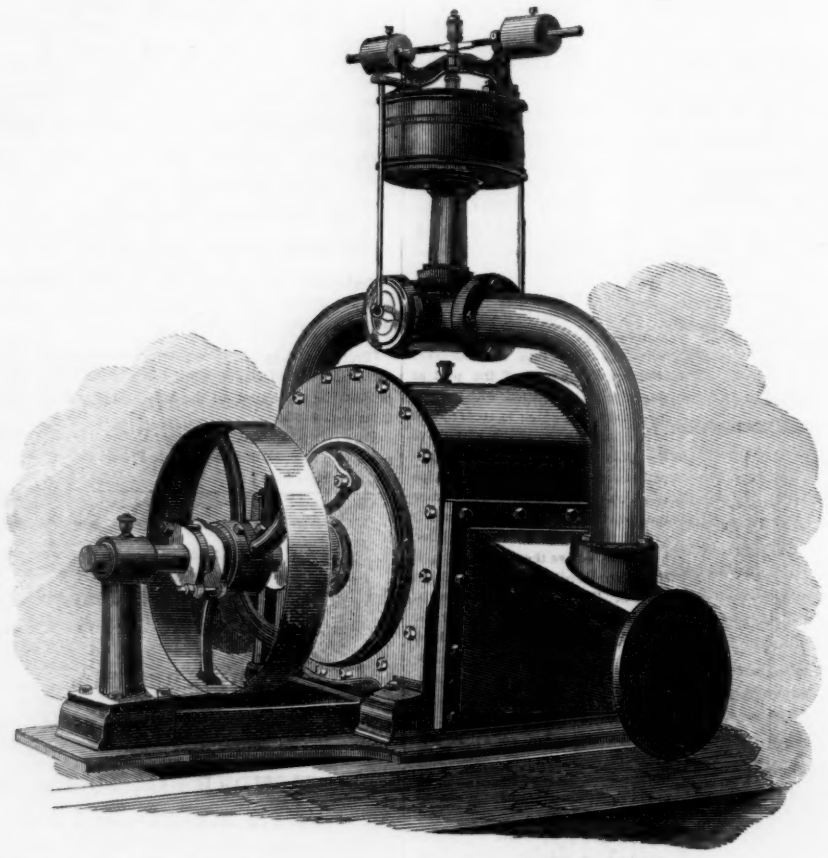

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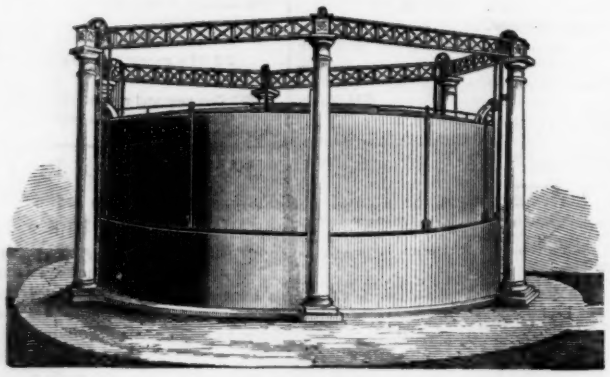

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FIG. 1.

Fig. 1 shows a single gate valve.

Fig. 2 represents wedge and one-half of gate.

Fig. 3, a section through body, gate and wedge, intended for larger sizes of water valves required to bear heavy pressure either side.

The slides, G G, are held against wedge D, by ribs, H H, projecting from sides of valve body, A.

In closing the valves, when opening I is covered, slides, G G, pass the lower ends of ribs, H H, when the wedge, D, can move forward on the inclined planes E E, and crowd the gates apart.

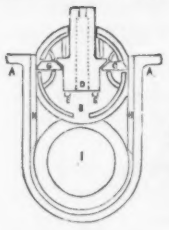

FIG. 3.

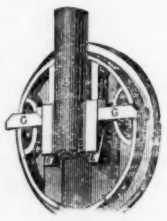

FIG. 2.

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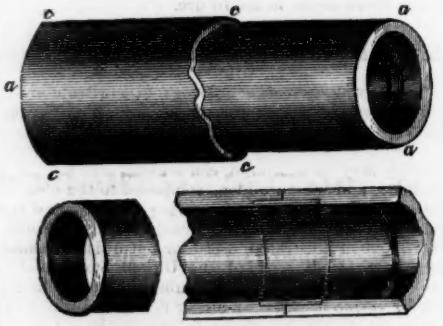


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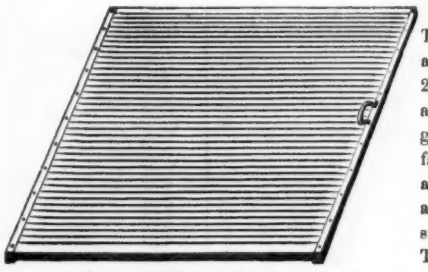

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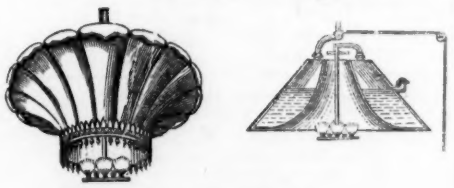

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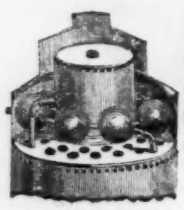

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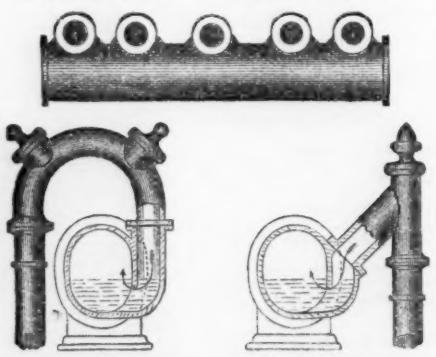

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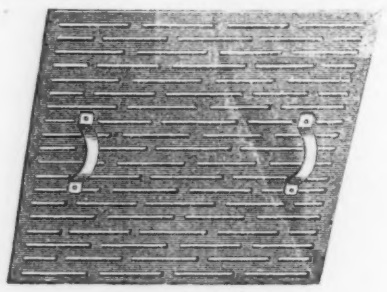

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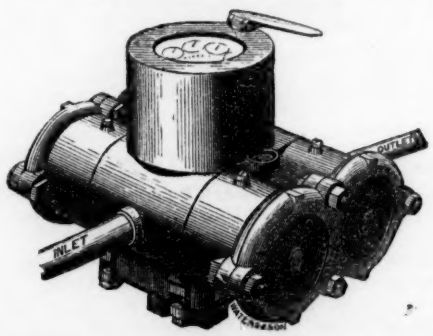


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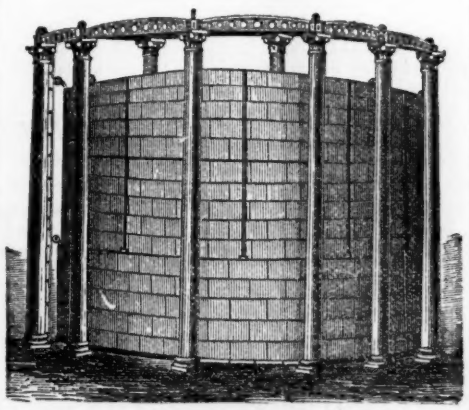

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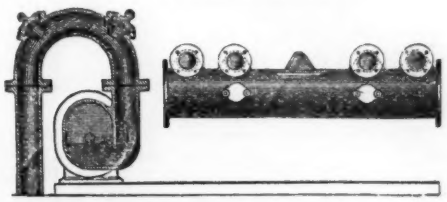

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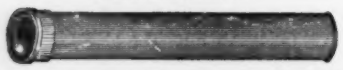

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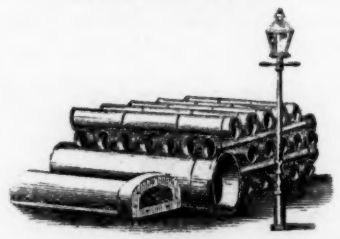

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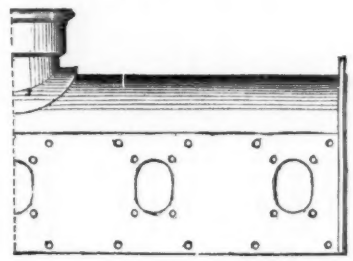

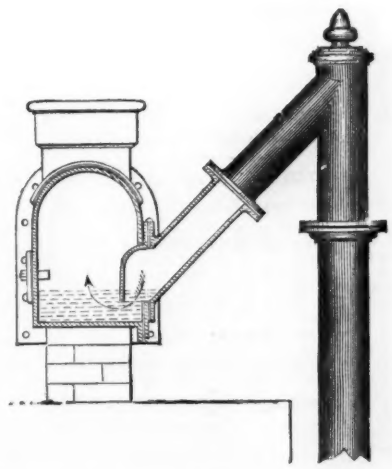

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